

The University of Chicago

DEVONIAN RUGOSE CORALS FROM
THE TRAVERSE BEDS
OF MICHIGAN

A PART OF A DISSERTATION SUBMITTED
TO THE FACULTY OF THE DIVISION OF THE
PHYSICAL SCIENCES IN CANDIDACY FOR THE
DEGREE OF DOCTOR OF PHILOSOPHY

DEPARTMENT OF GEOLOGY AND PALEONTOLOGY

1937

By
LAURENCE LOUIS SLOSS

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ABSTRACT—A three-fold division of the Middle Devonian Traverse beds of the northwestern part of the Lower Peninsula of Michigan is suggested. The rugose corals indicate that the Traverse beds were contemporaneous with the Hamilton group of New York and the Cedar Valley formation of Iowa. Two new genera and nine new species are described and figured. In view of the chaotic state of the taxonomy of rugose corals no attempt is made to assign the genera to families (the established families are polyphyletic), but their relationships are determined as far as possible. Turbidity of the water may have been a controlling factor in determining the form of the colony. Variation in solitary species may be due to differential growth, crowding, gerontism, and reproductive precocity. *Diversophyllum traversense* may be the solitary ancestor of the Mississippian compound genus *Lithostrotion*. The author of *Heliophyllum* is Dana rather than Hall.

THE TRAVERSE BEDS, at their type locality, comprise a series of calcareous shales and limestone cropping out on the shores of Grand Traverse and Little Traverse bays in the counties of Charlevoix and Emmet at the northwestern extremity of the Lower Peninsula of Michigan. The lower limits of the Traverse are not exposed; the upper limits are defined by the Waverlian black shales. On the west the area of outcrop is limited by Grand Traverse Bay; on the east by a thick overburden of drift. There is evidence to indicate that the Traverse beds are continuous under the drift with other limestones and shales on the eastern side of the Lower Peninsula. Some workers have extended the Traverse to include beds in western Ontario. The lithologic and faunal discrepancies are so marked however, that the writer feels that the name "Traverse" should be restricted to the western side of the Lower Peninsula.

The Traverse beds have been a subject for study by geologists for nearly 100 years, during which period much material has been published. Alexander Winchell (1866), in the appendix to a report on the Traverse Bay region, described, briefly and without benefit of published illustrations, 62 new species of fossils from the Traverse. Carl Rominger (1876) published the results of a geological survey of the Lower Peninsula and included a monographic work on the fossil corals of Michigan, among which many Traverse forms were described and figured. Rominger relied almost entirely on

external form for identification, and, although his figures are excellent, in many cases they fail to exhibit the diagnostic features. Many other workers have contributed shorter papers on the paleontology and stratigraphy of the Traverse. M. A. Fenton (1931) has described a stromatoporoïd reef, C. F. Deiss (1932) the fenestelloïd Bryozoa, G. M. Ehlers and T. E. White (1935) two rugose corals, R. W. Imlay (1935) a brachiopod, Ehlers and V. Kline (1935) revised Winchell's brachiopod types, and the ostracods have been worked by A. S. Warthin (1935).

E. R. Pohl (1929) has divided the Traverse into three stratigraphic units: the Gravel Point stage at the base, the Charlevoix stage in the middle, and the Petoskey formation at the top. The writer was unable to locate the "prominent angular unconformity" at the top of the Charlevoix stage mentioned by Pohl and believes that Pohl was confused by unusually high initial dips prevailing in the area due to the proximity of large bioherms. Until more and better evidence is brought forward the writer does not feel that the term "formation" is applicable to the beds involved; instead, it is proposed for the purposes of this paper to consider all three divisions as faunal zones.

The Gravel Point zone of the Traverse is correlated with the Alpena limestone of the eastern side of the Peninsula on the basis of the occurrence in each of the short-ranged coral *Heliophyllum juvene* (Rominger). Other diagnostic occurrences common

to the Alpena and Gravel Point are *Diversophyllum traversense* (Winchell) and *Chonophyllum ponderosum* (Rominger). Warthin and Cooper (1935) state that the upper part of the Alpena limestone may be correlated with the "coral zone" beds at Widder, Ontario, and the Centerfield member of the Ludlowville formation of the New York Hamilton. The writer has identified the Gravel Point zone species, *Heliophyllum juvene*, among corals from the "coral zone" beds at Widder associated with *Heliophyllum halli* forma *arachne*, a typical Ludlowville coral. A correlation between the Petoskey zone of the Traverse and the Potter Farm formation of the eastern side of the Peninsula is indicated by the occurrence in both of two species, *Disphyllum panicum* and *Hallia vesiculata*, n. sp. The Potter Farm formation overlies beds that have been shown to be Ludlowville in age by Warthin and Cooper (1935). Thus it would appear that on the basis of the rugose corals the Traverse beds should be considered Hamilton in age and correlative, at least in part, of the Ludlowville formation. In this connection it is interesting to note that except for the omnipresent *Cystiphyllum* not a single New York species of rugose coral is known from the Traverse beds, a few are found in eastern Michigan, and many species are common to Ontario and New York. A reason for this westward change in the fauna may be found in the influence exerted by the rising landmass of Appalachia, which flooded the Appalachian trough with clastic debris while the western portion of the seaway remained clear. Vaughan (1919) has demonstrated the extreme sensitivity of corals to turbidity.

The unpublished work of A. W. Slocum on proetid trilobites and Thomas (1920) on echinoderms has indicated that a relationship exists between the Devonian of Michigan and that of Iowa. With this in mind, the writer investigated the rugose coral fauna of certain horizons in the Iowa Devonian and found that a correlation between the Traverse beds and the Cedar Valley formation is indicated. The most diagnostic occurrence in the Cedar Valley is that of *Diversophyllum traversense* (Winchell), a species characteristic of the Gravel Point zone of the Traverse. The Iowa form differs slightly in that it lacks the thick epitheca of the

typical Traverse specimens, but this feature is one that would be subject to environmental control. Gerontic specimens from the type locality lack a thick epitheca and exhibit a lonsdaleioid proximal retreat of the septa; the latter character is also found in the Cedar Valley *Diversophyllum*. Also present in the Cedar Valley are an *Aulacophyllum* resembling *A. hemicrassatum*, n. sp., of the Petoskey zone, and a species resembling *Aulacophyllum mesodilatatum* n. sp. of the Gravel Point. The abundant *Prismatophyllum* of the Cedar Valley appears to be intermediate between *P. davidsoni* of the Onondaga and *P. percarinatum*, n. sp. of the Traverse. *Cystiphyllum americanum* is common to both areas. Thomas (1920, p. 409) considered the Cedar Valley to be late Devonian in age because of its position above the *Hypothyridina cuboides* zone; this determination has been followed by most later workers, including Stainbrook (1935, p. 255) who placed the Cedar Valley above the Independence shale, which he believed to be the base of the Upper Devonian in Iowa. If the apparent correlation of the Cedar Valley with the Traverse is valid, a Hamilton age for the Cedar Valley is indicated, thus casting doubt on the value of *Hypothyridina* as a marker.

CLASSIFICATION OF RUGOSE CORALS

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to criticize the theory from a purely biologic standpoint, but to the systematist it offers, by listing the trends a genus or species seems to follow, a means of eliminating a good deal of wordy description. The application of the theory also offers the best approach to the problem of rugose coral phylogeny. At the present time not nearly enough is known to attempt a reconstruction of Devonian coral phylogenesis, but it seems probable that after a few more years of work such as is being done in England by W. D. Lang and Stanley Smith it will be possible to divide properly the present polyphyletic genera and to assign each species to its correct stock. For the purposes of this paper the genera are not assigned to families, but they have been established along the time-accepted, probably erroneous, plan. The writer recognizes this deficiency but is unable to correct it at present.

ACKNOWLEDGMENTS

From the winter of 1935 to the spring of 1937 the writer studied Traverse corals at Walker Museum, University of Chicago, under the direction of Dr. Carey Croneis to whom the writer is pleased to acknowledge a great debt for the many hours of consultation and assistance rendered during the course of the research. The writer is greatly indebted to the late Mr. A. W. Slossom of Walker Museum for his aid in collecting material during the field season of 1936. The writer owes further thanks to Dr. G. M. Ehlers of the University of Michigan for the identification of Winchell's and Rominger's types, for the loan of photographs and permission to reproduce them here, and for two invaluable days during which the problem was discussed and many pertinent suggestions offered; to Dr. G. Arthur Cooper for the loan of specimens from the U. S. National Museum and for very valuable help rendered during two days in the field; to Dr. W. C. Allee of the Department of Zoology of the University of Chicago for information pertaining to ecology, variation and speciation; and to Drs. W. D. Lang and H. Deighton Thomas for very helpful criticism of the subject during two days spent at the British Museum (Natural History).

Topotype material and nitrocellulose peels taken from the type specimens of the

species described in this paper are to be deposited at the following institutions: Walker Museum, University of Chicago; University of Michigan, Ann Arbor; Stanford University, California; United States National Museum, Washington, D. C.; British Museum (Natural History), London.

SYSTEMATIC DESCRIPTIONS

Genus *TORTOPHYLLUM* Sloss, n. gen.

Genotype, *Tortophyllum cysticum* (Winchell).

Solitary corals with numerous steeply inclined rows of globose dissepiments, tabulae differentiated into a horizontal periaxial series and an inclined axial series, which is reflected in the calyx by a low calicular boss. The major septa extend to the axis, where they are twisted and joined together into a loosely knit axial complex. Minor septa characteristically long; dissepimentarium correspondingly wide. The corallum is without apparent symmetry and lacks a cardinal fossula, thus differing from *Phaulactis* Ryder (1926, p. 385).

Discussion.—The genus is evidently the result of aulophylloid and cystiphylloid trends. The first is evident in the structure of the axial complex, the second in the large number of dissepiments and the characteristically incomplete tabulae. Morphologically the genus is intermediate between a simple cyathophylloid and a complex clisiophylloid, but whether or not this represents the true phylogenetic position will not be known until more species are recognized and the trends established.

Superficially the genus resembles a large noncarinate *Macgeea*. Both forms have long, tapering septa, numerous concentric, globose dissepiments. Certain genera related to *Macgeea* lack horseshoe dissepiments and have differentiated tabulae as in *Tortophyllum*. The prominent trabeculae of the latter may represent incipient or vestigial carinae.

Occurrence.—The genus is known at present only from the Gravel Point and Petoskey zones of the Traverse in the Petoskey area, and from the Alpena limestone of the eastern area.

TORTOPHYLLUM CYSTICUM (Winchell)

Plate 11, figures 1–12, text figure 1

Zaphrentis cystica WINCHELL, 1866, The Grand Traverse Region, p. 90.

Lectotype.—Alma College, Michigan. One of two specimens in the Alma College collection marked 2724-t (for type). The lectotype is a small specimen cut longitudinally and transversely to show a section through the calyx and half of a transverse section. The specific characters are readily apparent. The other specimen is not sectioned but is obviously *Diversophyllum traversense* (Winchell). No locality number is given.

Original description.—Outer zone of finely vesicular tissue reaching nearly halfway to the center; central septa very thin and irregular; lamellae about 60, of which half terminate with the vesicular zone.

This inadequate description is not accompanied by any figures, published or un-

Transverse section: Thirty-eight to 46 major septa present; number varies with size and age of individual. Neanic stage of rare individuals exhibits cardinal, counter and alar septa; ephebic sections of all specimens retain no semblance of symmetry. Major septa extend to axis, where they characteristically join, twist, and become involved with elements of the tabularium to form ill-defined axial complex. Septa slightly dilate in dissepimentarium, taper rapidly in tabularium. Occasionally within dissepimentarium, more commonly at inner limit of dissepimentarium, septa are involved with one ring of dissepiments in a narrow stereozone. Average length of minor septa equal to one-third radius, may extend

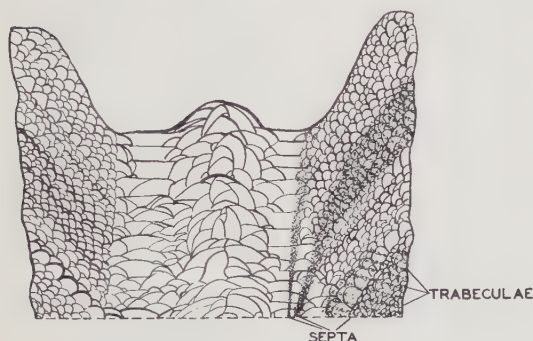


FIG. 1.—*Tortophyllum cysticum* (Winchell). Diagrammatic longitudinal and transverse sections, enlarged.

published. Therefore, it is necessary to append the following revised description.

External characters: Corallum simple, curved ceratoid to straight cylindrical. Maximum observed size 170 mm high, 60 mm in diameter; average 100 mm by 40 mm. Specimens commonly decorticated; where present, epitheca exhibits fine septal grooves, broad interseptal ridges, annular growth lines, and deep constrictions of rejuvenescence. Calyx depth equal to radius of corallum, walls descend abruptly from periphery to concave calicular pit; center occupied by low, rounded, calicular boss. Major septa straight, unornamented peripherally; join, twist, and become involved with other structures at axis. If twisting of distal ends of majors is prominent torsion is always counterclockwise. Minor septa much less prominent than majors.

to over two-thirds radius or be restricted to narrow peripheral border. Dissepiments numerous, concentrically arranged. Truncated edges of tabulae appear as concentric structures in tabularium.

Longitudinal section: Dissepiments numerous, small, globose, arranged in steeply inclined rows. Width of dissepimentarium varies with length of minor septa; may occupy wide border on either side of section or be restricted to three-millimeter-wide band. Tabulae characteristically incomplete, poorly differentiated into subhorizontal periaxial series and steeply inclined or domed axial series. Differentiation much more prominent in specimens with wide dissepimentaria.

When plane of section intersects plane of septum lying essentially parallel to it, septum exhibits prominent trabeculae spaced

0.5 mm apart, arched like carinae of *Helio-phyllum*.

Discussion.—The species exhibits a wide range of variation in form and internal structure. If only a small collection were available, it would be a simple matter to define several species, but the study of a large number of specimens indicates that all the variants intergrade.

The species is very common in the upper half of the Gravel Point zone of the Trav-

erse and is particularly characteristic of the "upper blue shale" at the top of the zone. Rare specimens are known in a large collection from the Petoskey zone; these all exhibit extreme break-down of the tabulae into tabellae and extreme doming in the axial area. Both these characters are considered by the writer to represent an advance over the more complete tabulae and less domed condition of the Gravel Point forms. It is possible that the Petoskey forms

EXPLANATION OF PLATE 9

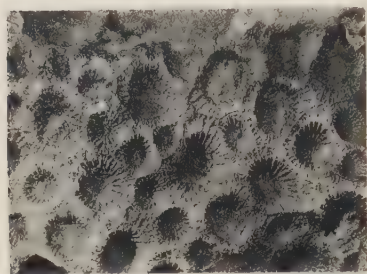
- FIGS. 1-8—*Streptelasma petoskeyense* Sloss, n. sp. Petoskey zone, U. S. Highway 31, 200 yards east of intersection of Michigan Highway 131, NE $\frac{1}{4}$ of NW $\frac{1}{4}$ sec. 34, T. 35 N., R. 5 W., Emmet County, Mich. 1, 2, Paratype (U. C. 38714), peels of longitudinal and transverse sections, $\times 1$; 3, holotype (U. C. 38715), peel of longitudinal section, $\times 1$; 4, paratype (U. C. 38716), thin section of immature transverse section, $\times 1$; 5, paratype (U. C. 38717), peel of longitudinal section, $\times 1$; 6, paratype (U. C. 38718), peel of longitudinal section, $\times 1$; 7, paratype (U. C. 38719), view of calyx, $\times \frac{1}{2}$; 8, paratype (U. C. 38720), lateral view, $\times \frac{1}{2}$. (p. 61)
- 9, 10—*Aulacophyllum hemicrassatum* Sloss, n. sp. Gravel Point zone, west end Petoskey Portland Cement Company quarry, SW $\frac{1}{4}$ sec. 2, T. 34 N., R. 6 W., Emmet County, Mich. Holotype (U. C. 38709), peels of longitudinal and transverse sections, $\times 1$. (p. 64)
- 11-13—*Aulacophyllum mesodilatum* Sloss, n. sp. Gravel Point zone, Bell quarry, 2.3 miles east of Charlevoix County line on U. S. Highway 31. NE $\frac{1}{4}$ sec. 8, T. 34 N., R. 6 W., Emmet County, Mich. 11, 12, Holotype (U. C. 38704), calicular and lateral views, $\times \frac{1}{2}$; peel of transverse section of holotype, $\times 1$. (p. 65)
- 14-17—*Heliophyllum juvene* (Rominger). Gravel Point zone, Bell quarry, 2.3 miles east of Charlevoix County line on U. S. Highway 31. NE $\frac{1}{4}$ sec. 8, T. 34 N., R. 6 W., Emmet County, Mich. 14, Hypotype (U. C. 38706), peel of longitudinal section, $\times 1$; 15, hypotype, (U. C. 38707), peel of transverse section, $\times 1$; 16, hypotype (U. C. 38705), thin section of longitudinal section, $\times 1$; 17, calicular view of same specimen as 15, $\times \frac{1}{2}$. (p. 58)
- 18-20—*Aulacophyllum bilaterale* Sloss, n. sp. Petoskey zone, U. S. Highway 31, 200 yards east of intersection of Michigan Highway 131, NE $\frac{1}{4}$ of NW $\frac{1}{4}$ sec. 34, T. 35 N., R. 5 W., Emmet County, Mich. Holotype (U. C. 38710), peels of longitudinal and transverse sections, $\times 1$. (p. 64)
- 21, 22—*Chonophyllum ponderosum* Rominger. Gravel Point zone, Bell quarry, 2.3 miles east of Charlevoix County line on U. S. Highway 31. NE $\frac{1}{4}$ sec. 8, T. 34 N., R. 6 W., Emmet County, Mich. Hypotype (U. C. 38700), calicular and lateral views, $\times \frac{1}{2}$. (p. 59)
- 23, 24—*Chonophyllum ovatum* Sloss, n. sp. Gravel Point zone, Bell quarry, 2.3 miles east of Charlevoix County line on U. S. Highway 31. NE $\frac{1}{4}$ sec. 8, T. 34 N., R. 6 W., Emmet County, Mich. Holotype (U. C. 38702), lateral and calicular views, $\times \frac{1}{2}$. (p. 60)
- 25—*Disphyllum panicum* (Winchell). Petoskey zone, Mud Lake quarry, NE $\frac{1}{4}$ of NW $\frac{1}{4}$ sec. 34, T. 35 N., R. 5 W., Emmet County, Mich. Hypotype (U. C. 38711), thin section, $\times 1$. (p. 68)
- 26, 27—*Disphyllum panicum* (Winchell). Petoskey zone, Northern Lime Company quarry, Petoskey, NE $\frac{1}{4}$ sec. 32, T. 35 N., R. 5 W., Emmet County, Mich. Hypotype (U. C. 38712), transverse and longitudinal sections, $\times 1$.

EXPLANATION OF PLATE 10

- FIGS. 1-5—*Prismatophyllum cristatum* (Rominger). Gravel Point zone, Bell quarry, 2.3 miles east of Charlevoix County line on U. S. Highway 31. NE $\frac{1}{4}$ sec. 8, T. 34 N., R. 6 W., Emmet County, Mich. 1, Hypotype (U. C. 38745), $\times \frac{1}{2}$; 2, 3, same specimen, peels of longitudinal and transverse sections, $\times 1$; 4, 5, hypotype (University of Michigan), thin sections of transverse and longitudinal sections (photographs courtesy G. M. Ehlers), $\times 1$. (p. 71)
- 6-9—*Prismatophyllum percarinatum* Sloss, n. sp. Gravel Point zone, Bell quarry, 2.3 miles east of Charlevoix County line on U. S. Highway 31. NE $\frac{1}{4}$ sec. 8, T. 34 N., R. 6 W., Emmet County, Mich. 6, Holotype (U. C. 38746), $\times 1$; 7, paratype (U. C. 38747), thin section, $\times 1$; 8, paratype (U. C. 38748), thin section, $\times 1$; 9, paratype (U. C. 38749), thin section $\times 1$. (p. 69)
- 10-13—*Prismatophyllum pauciseptatum* Sloss, n. sp. Petoskey zone, Mud Lake quarry, NE $\frac{1}{4}$ of NW $\frac{1}{4}$ sec. 34, T. 35 N., R. 5 W., Emmet County, Mich. 10-12, Holotype (U. C. 38752), peels, $\times 1$; 13, holotype, $\times \frac{1}{2}$. (p. 70)
- 14—*Prismatophyllum cristatum microcarinatum* Sloss, n. var. Gravel Point zone, Bell quarry, 2.3 miles east of Charlevoix County line on U. S. Highway 31. NE $\frac{1}{4}$ sec. 8, T. 34 N., R. 6 W., Emmet County, Mich. Holotype (U. C. 18402), $\times \frac{1}{2}$. (p. 72)



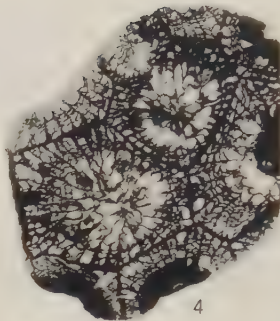
Sloss, Devonian Corals



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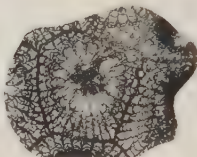
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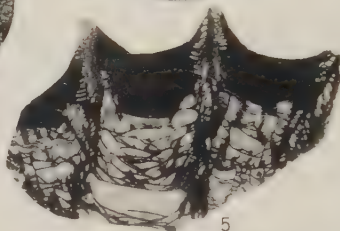
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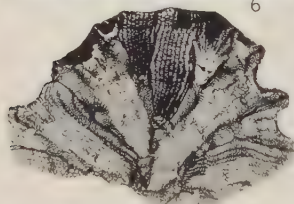
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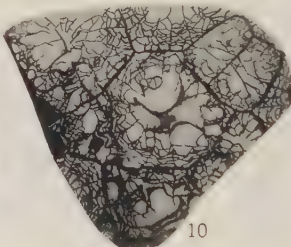
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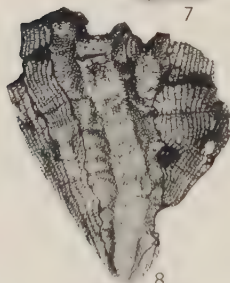
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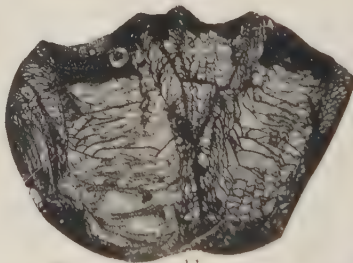
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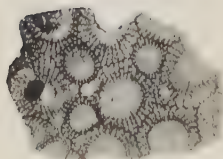
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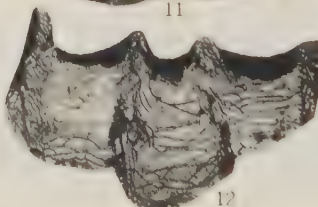
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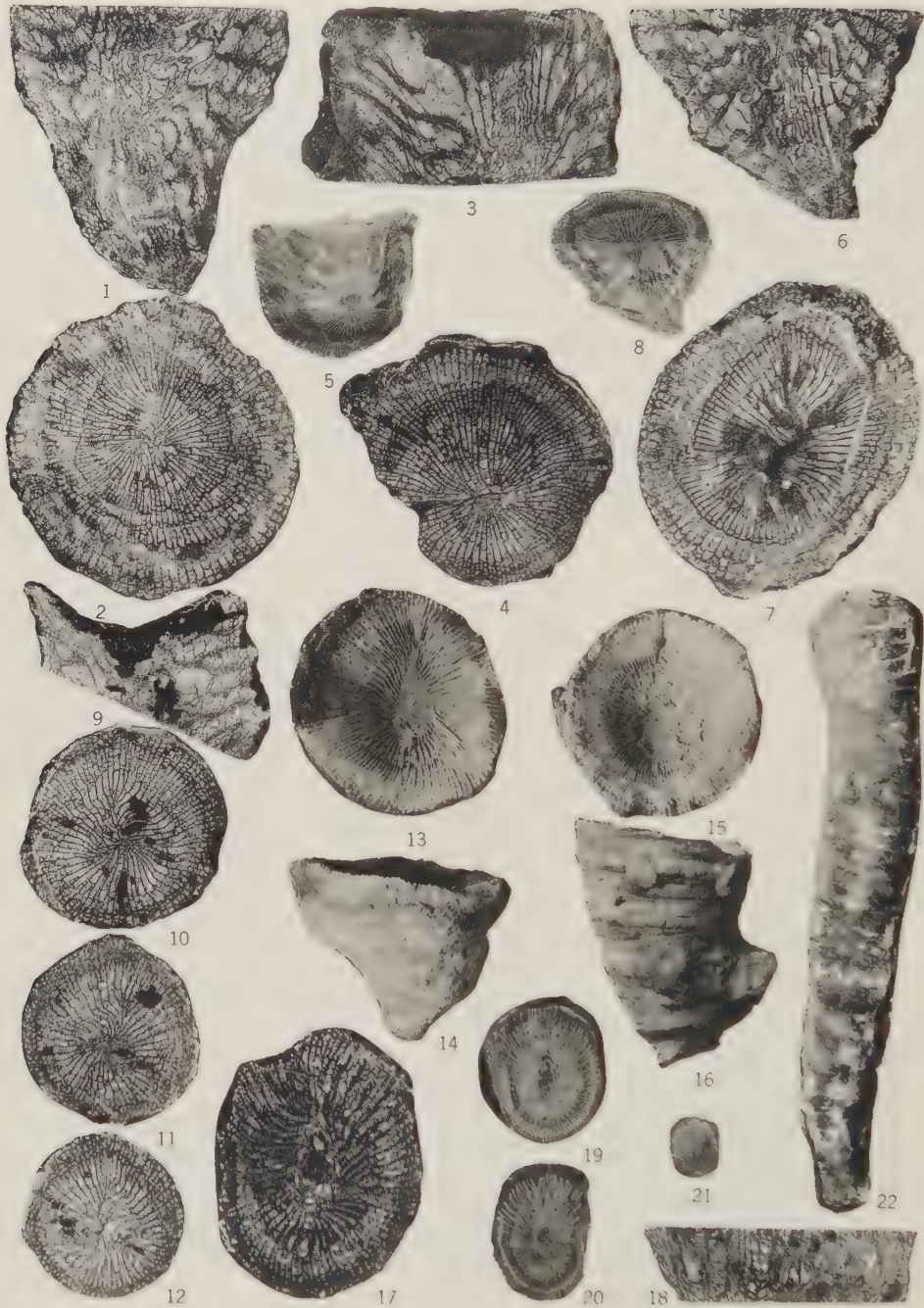


14

Sloss, Devonian Corals



Sloss, Devonian Corals



Sloss, Devonian Corals

should be separated as a distinct species.

In the lower Bell shale at Calcite, Mich., occurs a species that differs from *T. cysticum* in lacking a calicular boss and in having undomed axial tabulae.

Locality.—Winchell gives no locality for the single specimen in his collection, so the type locality for the species must remain unknown. It is probable, however, that the lectotype was collected from the lake-cliff outcrops of the Gravel Point at Petoskey, Mich.

Specimens in the writer's collection are from the following localities:

Gravel Point Zone

Bell quarry, 2.3 miles east of Charlevoix county line on U. S. Highway 31. NE $\frac{1}{4}$ sec. 8, T. 34 N., R. 6 W., Emmet County, Mich.

Lake cliffs at Bay View Station of Pennsylvania Railroad. NW $\frac{1}{4}$ sec. 32, T. 35 N., R. 5 W., Emmet County, Mich.

West end Petoskey Portland Cement Company quarry. SW $\frac{1}{4}$ sec. 2, T. 34 N., R. 6 W., Emmet County, Mich.

Petoskey Zone

"Mud Lake" quarry. East Bay View (Kegonic), Mich. NE $\frac{1}{4}$ of NW $\frac{1}{4}$ sec. 34, T. 35 N., R. 5 W., Emmet County, Mich.

Repository of type material.—Lectotype;

EXPLANATION OF PLATE 11

- FIGS. 1-10—*Tortophyllum cysticum* (Winchell). Gravel Point zone, I. Bell quarry, 2.3 miles east of Charlevoix County line on U. S. Highway 31. NE $\frac{1}{4}$ sec. 8, T. 34 N., R. 6 W., Emmet County, Mich. 1, Hypotype (U. C. 38624), $\times \frac{1}{2}$; 2, section of same specimen, $\times \frac{1}{2}$; 3, peel of transverse section of same specimen, $\times 1$; 4, peel of transverse section of hypotype (U. C. 38725), $\times 1$; 5, thin section of longitudinal section, same specimen, $\times 1$; 6, hypotype (U. C. 38726), view of eroded calyx, $\times \frac{1}{2}$; 7, hypotype (U. C. 38727), peel of transverse section, $\times 1$; 8, hypotype (U. C. 38728), peel of longitudinal section, $\times 1$; 9, same specimen, thin-section of immature transverse section, $\times 1$; 10, hypotype (U. C. 38729), peel of longitudinal section, $\times 1$. (p. 54)
- 11, 12—*Tortophyllum* cf. *T. cysticum* (Winchell). Petoskey zone, Mud Lake quarry, NE $\frac{1}{4}$ of NW $\frac{1}{4}$ sec. 34, T. 35 N., R. 5 W., Emmet County, Mich. Peels of longitudinal and transverse sections of a specimen (U. C. 38732), doubtfully referred to the species, $\times 1$. (p. 54)
- 13—*Diversophyllum traversense* (Winchell). Previously unpublished drawing made for Winchell at time of original description of the holotype of the species but not included in original publication; bears Winchell's handwriting, designating the type specimen, which is now at the Hood Museum, Alma College, Mich. Drawing at University of Michigan. (Photograph courtesy G. M. Ehlers.) (p. 66)
- 14-23—*Diversophyllum traversense* (Winchell). Gravel Point zone, Bell quarry, 2.3 miles east of Charlevoix County line on U. S. Highway 31. NE $\frac{1}{4}$ sec. 8, T. 34 N., R. 6 W., Emmet County, Mich. 14, Hypotype (U. C. 38733), view of the calyx, $\times \frac{1}{2}$; 15, same specimen, peel of transverse section, $\times 1$; 16, hypotype (U. C. 38734), peel of transverse section of specimen with flat tabulae and wide dissepimentarium, $\times 1$; 17, lateral view of the same specimen, $\times \frac{1}{2}$; 18, hypotype (U. C. 38735), thin-section of longitudinal section of specimen exhibiting highly domed tabulae and a restricted dissepimentarium, $\times 1$; 19, 20, hypotype (U. C. 38736), peels of longitudinal and transverse sections, $\times 1$; 21, side view of same specimen showing lateral bud, $\times \frac{1}{2}$; 22, 23, hypotype (U. C. 38737), peels of transverse and longitudinal sections of a specimen exhibiting intermediate characters, $\times 1$. (p. 66)

EXPLANATION OF PLATE 12

- FIGS. 1-8—*Hallia vesiculata* Sloss, n. sp. Petoskey zone, NE $\frac{1}{4}$ of NW $\frac{1}{4}$ sec. 34, T. 35 N., R. 5 W., Emmet County, Mich. 1, 2, Holotype (U. C. 38738), peels of transverse and longitudinal sections, $\times 1$; 3, 4, paratype (U. C. 38739), peels of longitudinal and transverse sections, $\times 1$; 5, same specimen, $\times \frac{1}{2}$; 6, 7, paratype (U. C. 38753), peels of longitudinal and transverse sections, $\times 1$; 8, same specimen, $\times \frac{1}{2}$. (p. 62)
- 9-12—*Hallia vesiculata* Sloss, n. sp. Petoskey zone, U. S. Highway 31, 200 yards east of intersection of Michigan Highway 131, NE $\frac{1}{4}$ of NW $\frac{1}{4}$ sec. 34, T. 35 N., R. 5 W., Emmet County, Mich. Paratype (U. C. 38742), peels of longitudinal and transverse sections of an immature specimen, $\times 1$. (p. 62)
- 13-16—*Hallia vesiculata* Sloss, n. sp. Petoskey zone, Mud Lake quarry, NE $\frac{1}{4}$ of NW $\frac{1}{4}$ sec. 34, T. 35 N., R. 5 W., Emmet County, Mich. 13, 14, Paratype (U. C. 38740), $\times \frac{1}{2}$; 15, 16, paratype (U. C. 38741), $\times \frac{1}{2}$. (p. 62)
- 17-21—*Hallia zonata*, Sloss, n. sp. Petoskey zone, Mud Lake quarry, NE $\frac{1}{4}$ of NW $\frac{1}{4}$ sec. 34, T. 35 N., R. 5 W., Emmet County, Mich. 17, 18, Holotype (U. C. 38743), peels of transverse and longitudinal sections, $\times 1$; 19-21, holotype, $\times \frac{1}{2}$. (p. 63)
- 22—*Diversophyllum traversense* (Winchell). Gravel Point zone, west end Petoskey Portland Cement Company quarry, SW $\frac{1}{4}$ sec. 2, T. 34 N., R. 6 W., Emmet County, Mich. Hypotype, (U. C. 38744), $\times \frac{1}{2}$. (p. 66)

Alma College, Alma, Mich. Hypotypes, Walker Museum, Univ. of Chicago.

Genus *HELIOPHYLLUM* Dana, 1846

DANA, 1846, U. S. Exp. Ex. VIII, "Zoophytes," p. 356, pl. 26, fig. 3. Emend. MILNÉ-EDWARDS and HAIME, 1850, British Fossil Corals, pp. lxi, 235.

Genotype, *Heliophyllum halli* Milne-Edwards and Haime, 1850.

Original description.—From the discussion of the genus *Cyathophyllum* in Dana's "Zoophytes" (1846, p. 356):

There are others in which the dissepiments run *upward* and inward, as represented in plate 26, figures 3, 4, and 4a; and as the species have also some difference in habit, they constitute a subgenus, if not a wholly distinct group. The name *Heliophyllum* has been applied by Mr. James Hall to a specimen of this kind in his cabinet, and may well be retained. It is represented in his N. Y. Geological Report, fig. 3, p. 209, and is probably near the *Cyathophyllum helianthoides* of Goldfuss, plate 20, fig. 2.

The subgenus *Heliophyllum* will then contain species having generally the transverse septa of the *Cyathophylla*, but with the intermediate dissepiments running oblique *upward* and inward.

Emended description.—Corallum simple. Septal apparatus well developed, and producing lateral lamellar prolongations, which extend from the wall towards the centre of the visceral chamber, so as to represent ascending arches, and to constitute irregular central *tabulae*, and which are united towards the circumference by means of vertical dissepiments (Milne-Edwards and Haime, 1850, p. lxi).

Discussion.—Previous workers have been unanimous in considering *Heliophyllum* as one of Hall's genera, but in the opinion of the writer this is erroneous. Hall is responsible for the name but used it only on a museum specimen and in conversation with Dana; he was not responsible for the generic diagnosis or figure published by Dana.

On this point the International Rules of Zoological Nomenclature read as follows:

Article 21.—The author of a scientific name is that person who first publishes the name in connection with an indication, a definition, or a description, unless it is clear from the contents of the publication that some other person is responsible for said name and its indication, definition, or description.

The meaning of the word "indication" with regard to generic names is construed by the International Commission on Zoological Nomenclature as follows:

(1) A bibliographic reference, or (2) a definite citation of an earlier name for which a new name

is proposed, or (3) the citation or designation of a type species.

In no case is the word "indication" to be construed as including museum labels, museum specimens, or vernacular names.

By monotypy the species described and figured by Hall (1843, p. 209) as *Strombodes helianthoides* (Goldfuss) is the genotype. Hall identified the New York form in question from a description and figure published by Phillips (1841, p. 10), who identified his specimens as *Cyathophyllum helianthoides* Goldfuss, but referred the species to the genus *Strombodes* Schweigger. Milne-Edwards and Haime (1850) upon examining Phillips' specimens discovered that they were misidentified, thus making *Heliophyllum helianthoides* a homonym. This they rectified by renaming the species *H. halli*.

Heliophyllum is represented by one species in the Traverse. Many species have been described from the Hamilton group, but Wells (1937) has shown that, at least for a single horizon, only one biologic unit is present and the other "species" are of varietal rank.

HELIOPHYLLUM JUVENE (Rominger)

Plate 9, figures 14–17

Cyathophyllum juvenis ROMINGER, 1873, Michigan Geol. Survey, vol. 3, pt. 2, p. 101.—*Not Cyathophyllum juvenis* DAVIS, 1885, Kentucky Fossil Corals, pls. 79, 80.

Heliophyllum juvenis CALVIN, 1888, Am. Geologist., vol. 1, p. 83. *Fide* Whiteaves, 1898.—WHITEAVES, 1898, Contr. Canadian Paleontology, vol. 1, pt. 5, p. 365.—*Not* WERNER, 1932, Washington Univ. [St. Louis] Studies, new ser., no. 7, p. 117.

Syntypes.—Rominger's types are at the University of Michigan. No type locality is given, the type specimens being collected from Widder, Ontario, and Little Traverse Bay.

External characters: Corallum simple, curved ceratoid. Average height 50 mm, diameter 20 mm. Epithecium thin, with faint septal grooves and growth lines. Coarse rugae indicate periodic rejuvenescence of corallum. Calyx depth about equal to radius; walls descend in convex curve to small concave calicular floor. Axis commonly eccentric in direction of curvature. Major septa approximately 30 in number, straight, persistent to axis; minors finer, shorter; both series bear denticulate edges and yard-arm carinae.

Transverse section: Distal ends of major septa commonly anastomose and twine at axis. Minors extend two-thirds distance from periphery to axis. Carinae appear as opposed diamond-shaped areas on septa. Inner limit of dissepimentarium marked by ring of prominent dissepiments, other dissepiments fine, subordinate to carinae.

Longitudinal section: Carinae appear as continuous ridges on septa ascending in an arc from periphery to axis, spaced about 0.4 mm apart. Dissepiments numerous, globose, arranged in steeply dipping rows. Tabularium filled with undifferentiated tabellae.

Discussion.—The writer has compared specimens of *Heliophyllum juvene* from the Gravel Point zone (to which the species is confined in the western area) with specimens from the "coral zone" of the Widder Beds near Thedford, Ontario, and found them to be conspecific. The specimens from the upper Helderberg and Onondagan that have been referred to *H. juvene* have proved to be misidentifications in each case investigated by the writer.

H. juvene is possibly synonymous with *Heliophyllum tenuiseptatum* Billings (1859, p. 126), also described from the Hamilton of Ontario, but until Billings' type is actually compared with *H. juvene* it is safer to retain Rominger's name.

A coral that closely resembles *H. juvene* occurs in the Upper Bell formation at Rockport, Mich. The Bell species differs in having shorter septa, less prominent carinae, and more nearly complete tabulae; it may be regarded as being more primitive than *H. juvene*.

Localities.—The species is very common in the upper part of the Gravel Point zone, particularly the "blue shale" at the following localities:

Bell quarry, two miles east of Charlevoix County line on U. S. Highway 31. NE $\frac{1}{4}$ sec. 8 T. 34 N., R. 6 W., Emmet County, Mich.

Lake cliffs at Bay View Station, Pennsylvania Railroad. NW $\frac{1}{4}$ sec. 32, T. 35 N., R. 5 W., Emmet County, Mich.

West End Petoskey Portland Cement Company quarry. SW $\frac{1}{4}$ sec. 2, T. 34 N., R. 6 W., Emmet County, Mich.

Genus CYSTIPHYLLUM Lonsdale, 1839

LONSDALE in MURCHISON, 1839, Silurian System pt. 2, p. 691.

Discussion.—The corals that have been

included in *Cystiphyllum* are the end products of cystiphylloid trends in widely separated stocks. Since most of the diagnostic characters are obliterated by the great development of undifferentiated dissepiments and tabellae the convergence of forms of varied phylogenesis is extreme. Therefore the genus can not be considered as a group of biologically related units nor can much stratigraphic significance be derived from its occurrence.

The following "species" have been recognized in the Gravel Point zone:

Cystiphyllum americanum Milne-Edwards and Haime, 1851, Polypiers fossiles terrain paleozoique, p. 464, pl. 13.

Cystiphyllum varians Hall, 1896, Illinois Devonian fossils, pl. 29.

Cystiphyllum cf. *C. lamellosum* (Goldfuss), 1826, Petref. Germ., pt. 1, p. 58, pl. 18, fig. 3.

C. americanum is one of the most common fossils in the upper part of the zone.

The following species of *Cystiphyllum* occur in the Petoskey zone:

Cystiphyllum americanum

Cystiphyllum cf. *C. aggregatum* Billings, 1859, Canadian Journ., n. ser., vol. 4, p. 137, fig. 28.

The latter form, a compound species, occurs in large masses near the base of the Petoskey zone.

Genus CHONOPHYLLUM Milne-Edwards and Haime, 1850

MILNE-EDWARDS and HAIME, 1850, British Fossil Corals, p. 49.

Genotype, *C. perfoliatum* Milne-Edwards and Haime = *Cyathophyllum plicatum* Goldfuss, 1826, Petref. Germ., pl. 18, fig. 5, not pl. 15, fig. 12.

Original description.—Corallum simple, and constituted principally by a series of infundibuliform tabulae, superposed and invaginated, the surface of which presents numerous septal radii equally developed, and extending from the centre to the circumference. No columella nor walls (Milne-Edwards and Haime, 1850, p. lxix).

CHONOPHYLLUM PONDEROSUM Rominger Plate 9, figures 21, 22

Chonophyllum ponderosum ROMINGER, 1876, Michigan Geol. Survey, vol. 3, pt. 2, p. 117.

Original description.—Patellate, depressed, conical polyparia of irregular, unsymmetrical, clumsy growth, with gemmation from the centre of the calyces, of new single cells, or, in rare instances, of from two to four confluent or imperfectly defined calyces. End cells shallow, explanate at the margins, more abruptly depressed

in the centre, which is surrounded by a circle of low, linear crests uniting in it with twisted ends. Expanded marginal part radiated by flat, band-like plications of papillose surface. The specimens are all formed of a heavy, compact mass of amorphous, white, ivory-like carbonate of lime, or partly silicified, and with scarcely a trace of the organic structure preserved; only in a few specimens could enough of it be seen by which to recognize the generic relations of the specimens and their correspondence with *Chonophyllum*. It does not seem to be the mode of petrification which obscures the structure as we find this coral in different localities associated with other corals exhibiting the finest details of structure, while they everywhere present the same massive, compact condition. The coral appears to have, during the progress of its growth, filled out its cellulose cavities as soon as the fleshy parts of the animal abandoned them.

... [the species] is abundant in certain layers of the Hamilton Group at Thunder Bay, and is also found at Little Traverse Bay (Rominger, 1876, p. 117).

Discussion.—The species occurs in the upper part of the Gravel Point zone, but good specimens are very scarce. The writer has hesitantly referred to this species certain incomplete coralla which appear to be young examples. These do not exhibit the repeated extreme rejuvenescence of the typical specimens, nor are they so heavily invested with structureless calcite. A coral closely resembling the Gravel Point species occurs in the upper Alpena limestone at Alpena, Michigan.

Locality.—Specimens in the writer's collection are from the "blue shale" of the Gravel Point zone at locality 1, NE $\frac{1}{4}$ sec. 8, T. 34 N., R. 6 W., Emmet County, Mich.

Holotype.—University of Michigan, Ann Arbor. Comparative material at Walker Museum, University of Chicago.

CHONOPHYLLUM OVATUM Sloss, n. sp.

Plate 9, figures 23, 24

External characters: Corallum simple, erectly turbinate. Height of holotype 37 mm, width at cardinal septum 52 mm, at alar septa 45 mm. Epitheca smooth. Calyx shallow, calicular pit 12 mm in diameter, surrounded by broad, gently sloping calicular platform. Axis eccentric in direction of counter septum. Eighty-four septa appear as broad ridges separated by narrow grooves on calicular platform, majors project as fine blades into calicular pit, complexly in-

tertwined at axis; minors project only slightly beyond calicular platform. Septa of cardinal quadrants pinnately arranged about long prominent cardinal septum.

Transverse section: restricted axial complex filled with intertwined distal ends of major septa. Remainder of lumen occupied by dense white organic calcite, in which interseptal loculi appear as fine dark lines.

Longitudinal section: Axial complex tapers but slightly toward base of corallum. Remainder of lumen occupied by dense, white organic calcite in which tabulae appear as closely spaced, axially inclined, fine lines.

Discussion.—The inclusion of this species in *Chonophyllum* is purely provisional. Although the *Hallia*-like character of the septal symmetry seems to indicate a generic distinction, the writer hesitates to erect a new genus on the scanty material now available. It seems probable, however, that the dense filling of the lumen represents an end stage in a petraeoid trend which might arise in several stocks.

The species is at present represented by only three specimens, all collected from the top of the Gravel Point zone.

Type locality.—Bell quarry, 2.3 mi. east of Charlevoix County line on U. S. Highway 31. NE $\frac{1}{4}$ sec. 8, T. 34 N., R. 6 W., Emmet County, Mich.

Other locality "Upper blue shale," Gravel Point zone, lake bluffs at Bay View Station, Pennsylvania Railroad, NW $\frac{1}{4}$ sec. 32, T. 35 N., R. 5 W., Emmet County, Mich.

Type material.—Holotype and paratypes at Walker Museum, University of Chicago. Holotype, U. C. no. 38702.

Genus STREPTELASMA Hall, 1847

HALL, 1847, *Paleontology of New York*, vol. 1, p. 17.

Genotype, *Streptelasma corniculum* Hall, by subsequent designation (Roemer, 1861, p. 19).

Hall's inadequate original description has been revised by Stanley Smith as follows:

Simple, trochoid or conical rugose corals, in which the more or less denticulate axial edges of the major septa twist to form a loosely built axial structure. In the brephic stages the septa are usually much dilated, and are laterally contiguous; but in the ephebic stage the dilation is generally restricted to the peripheral border,

where the short minor septa are fused to the major by stereome to form a narrow stereozone. The irregular tabulae slope downwards and towards the periphery. Dissepiments are typically suppressed (Smith, 1930, p. 311).

Discussion.—*Streptelasma* has become a waste-basket genus in which have been placed many species of structure so generalized that their true relationships are not clear. The writer realizes the probability that the genus is highly polyphyletic but is at a loss at present for a better means of disposing of a species whose structure corresponds to *Streptelasma* but whose phylogenesis is unknown.

STREPTELASMA PETOSKEYENSE

Sloss, n. sp.

Plate 9, figures 1–8, text figure 2

External Characters: Corallum simple, trochoid to ceratoid; average 35 mm high, 20 mm in diameter at top of calyx. Epitheca thick, ornamented with low interseptal ridges and conspicuous growth lines. Calyx normally shallow, flat-floored, but quite variable.

Transverse section: Peripheral stereozone prominent. The 32 major septa continuous to axis in neanic and early ephebic stages, characterized by amplexoid shortening in later stages. Septa markedly dilate in early stages, relatively thin in later stages. Rare specimens exhibit poorly developed cardinal fossula occupied by a reduced septum. Minor septa visible only as fine lines in peripheral stereozone of neanic stage, extend one-third distance to axis in ephebic stage of large specimens. Dissepiments rare.

Longitudinal section: Tabulae numerous, characteristically complete, horizontal or slightly domed. Dissepiments, if present, confined to a single subvertical row in ephebic portion of corallum.

Discussion.—The affinities of the species are unknown at present. It is hoped that future detailed work on the ontogeny of *Streptelasma* will reveal the relationships of the forms included in the group.

Type locality.—Grass-roots at roadside, and bed of small stream $1\frac{1}{2}$ miles east of Bay View, on U. S. Highway 31, 200 yards east of the intersection of Michigan Highway 131. NE $\frac{1}{4}$ of NW $\frac{1}{4}$ sec. 34, T. 35 N., R. 5 W., Emmet County, Mich.

Other locality.—“Mud Lake quarry,” East Bay View, NE $\frac{1}{4}$ of NW $\frac{1}{4}$ sec. 34, T. 35 N., R. 5 W., Emmet County, Mich.

Type material.—Holotype, Walker Museum, University of Chicago. U. C. no.

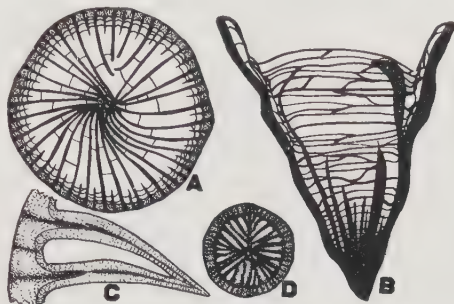


FIG. 2.—*Streptelasma petoskeyense* Sloss, n. sp. A, B, Diagrammatic transverse and longitudinal sections, $\times 1\frac{1}{2}$; C, diagrammatic section through neanic septa exhibiting marked dilation, $\times 5\frac{1}{2}$; D, diagrammatic neanic transverse section, $\times 1\frac{1}{2}$.

38715. Paratypes, Walker Museum, University of Chicago.

Genus *HALLIA* Milne-Edwards and Haime, 1850

MILNE-EDWARDS and HAIME, 1850, British Fossil Corals, p. lxxvii.

Genotype, *Hallia insignis* Milne-Edwards and Haime.

Original description.—Corallum tall, turbinate, septa highly developed and extending to the centre of the tabulae. No columella. One remarkable large primary septum occupying the place of the septal fossula, and the neighbouring septa directed towards it so as to assume a pinnate arrangement; the septa belonging to the two other systems presenting the usual radiate position (Milne-Edwards and Haime, 1850, p. lxxvii).

Discussion.—The species placed in *Hallia* by Milne-Edwards and Haime (1851, p. 353) and Hall (1882, p. 411) do not all exhibit the very prominent cardinal septum in the calyx mentioned in the original description, but all have in common a narrow groovelike fossula occupied by a long cardinal septum. This is also a character of the *Traverse* species, which exhibit, in transverse section, a strong cardinal septum persistent to the axis, and about which the septa of the cardinal quadrants are pinnately arranged. Except for the long cardinal

septum the genus is identical with *Aulacophyllum*.

HALLIA VESICULATA Sloss, n. sp.

Plate 12, figures 1-16, text figure 3

External characters: Corallum simple, trochoid, curved ceratoid to cylindrical, typical trochoid specimens measure 50 mm high, 55 mm in diameter. Typical ceratoid

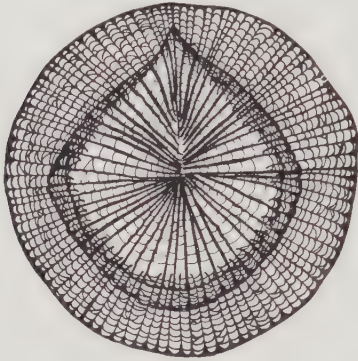


FIG. 3.—*Hallia vesiculata* Sloss, n. sp. Diagrammatic transverse section, $\times 1\frac{1}{2}$.

specimens 80 mm high, 45 mm in diameter. One cylindrical specimen 150 mm by 50 mm. Epitheca thin, with well developed growth rings, calyx deep, paraboloid, with a narrow, shallow cardinal fossula about which septa of cardinal quadrants are pinnately arranged. Calicular edges of septa denticulate; denticulations correspond to slight undulations, which traverse septa at right angles to their calicular edges.

Transverse section: Fifty to 56 major septa, those of cardinal quadrants pinnately arranged to converge upon a long, persistent cardinal septum. Septa of counter quadrants radially arranged. Pinnate symmetry best developed in neanic stage, later obscured by secondary radiality. Minor septa extend one-half to three-quarters the distance to the axis, are contraingent (Smyth, 1937) in neanic stage, contraclined ephebically. Narrow pendant-shaped stereozone involving one or two rows of dissepiments present near the axial margin of the dissepimentarium, point of pendant being at cardinal septum. In some individuals the stereozone has accessory points at the alar septa, making it kite-shaped in outline. All septa slightly dilate within tabularium.

Longitudinal section: No tabulae, entire lumen occupied by undifferentiated dissepiments and tabellae arranged in closely spaced series of synclinal paraboloid curves. Where septa are essentially parallel to plane of section undulations appear as jagged serrations disposed like the carinae of *Heliophyllum*. Septal trabeculae appear as striations intimately associated with undulations on plane of septum.

Discussion.—This species appears to be close to "*Odontophyllum*" *convergens* (Hall) from the Sellersburg limestone of Indiana, but differs from that form externally in having a deeper calyx, a more shallow fossula, and a more erect corallum.

The most interesting feature of the species is the extreme variation in the shape of the corallum from trochoid or nearly turbinate forms to cylindrical shapes. The extremes of the variational series, trochoid and subcylindrical, appear to be more common than the intermediate shapes; originally therefore, it was thought possible to divide the species on this basis, but further examination of the material has revealed a complete, intergraded series. The occurrence in the same horizon at the same locality of varied shapes in the same species can not be explained wholly on the basis of environmental influence, for different shapes occur side by side in the shale. Wells (1937, p. 8), working on *Heliophyllum halli*, has indicated that the following factors may be operative:

1. Reproductive precocity.
2. Stability
 - a. Stability: straight or regularly curved corallum.
 - b. Instability: contortion of corallum.
3. Gerontism: gerontic contraction of corallum.
4. Irregularity of rejuvenescence.
5. Differential growth-rate
 - a. Growth-rate of polyp faster than development of corallum: turbinate or patelliform.
 - b. Variation in growth-rate of parts of polyp: reflexed calicular margin, or deep calicular pit.

Hallia vesiculata is a common coral in the Petoskey zone at Mud Lake and in the Potter Farm formation of the eastern area.

Type locality.—Petoskey zone, "Mud Lake" quarry, East Bay View, NE $\frac{1}{4}$ of NW $\frac{1}{4}$ sec. 34, T. 35 N., R. 5 W., Emmet County, Mich.

Other locality.—Grass roots and bed of small stream $1\frac{1}{2}$ miles east of Bay View on U. S. Highway 31, 200 yards east of intersection of Michigan Highway 131. NW $\frac{1}{4}$ sec. 34, T. 35 N., R. 5 W., Emmet County, Mich.

Holotype.—Walker Museum, U. C. no. 38738.

HALLIA ZONATA Sloss, n. sp.

Plate 12, figures 17–21, text figure 4

External characters: Corallum simple, ceratoid, height of holotype, 75 mm; diameter at cardinal septum, 45 mm; diameter at alar septa, 38 mm. Calyx not fully known; apparently deep, paraboloid. Epitheca thin, ornamentation fine.

Transverse section: Ephebic stage: 46 major septa present. Cardinal septum persistent to axis, dilated by distal paliform lobe. Major septa of cardinal quadrants dilated from periphery to axis, pinnately arranged about cardinal septum; dilation confined to tabularium in counter quadrants. Minor septa contratingent, undilated. Dissepimentarium of counter quadrants bears U-shaped stereozone 2 mm wide, 1 mm from epitheca. Dissepiments numerous, fine, concentric.

Neanic stage: Only septa of cardinal quadrants markedly dilate. Subperipheral stereozone complete in all quadrants.

Longitudinal section: Dissepimentarium occupied by steeply dipping rows of numerous small globular dissepiments. Tabularium occupied by numerous small tabellae of uncertain orientation. Structures much obscured by dilate septa.

Discussion.—Although the species is known from only one specimen, it is felt that the characters are sufficiently distinct and peculiar to justify the establishment of a new species. The corals associated with the specimen are not markedly crushed except in the calicular portion; therefore it is assumed that the ellipsoid shape of the corallum is natural. The fact that the axes of the ellipse are oriented with the proto-septa of the coral is another point in favor of this argument.

Stereozones are characteristic of *Hallia* and *Aulacophyllum*, but the writer has not seen another coral with the peculiar pattern exhibited by this species. The neanic stage, however, exhibits a stereozone pattern quite similar to that seen in more common

species of *Hallia* and *Aulacophyllum*; so it is probable that *H. zonata* represents an aberrant development of the trend.

Type locality.—Petoskey zone, "Mud Lake" quarry, East Bay View, NE $\frac{1}{4}$ sec. 34, T. 35 N., R. 5 W., Emmet County, Mich.

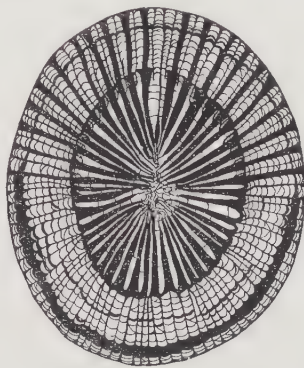


FIG. 4.—*Hallia zonata* Sloss, n. sp. Diagrammatic transverse section, $\times 1\frac{1}{2}$.

Holotype.—Walker Museum. U. C. no. 38743.

Genus *AULACOPHYLLUM* Milne-Edwards and Haime, 1850

MILNE-EDWARDS and HAIME, 1850, British Fossil Corals, p. lxvii.

Genotype, *Aulacophyllum sulcatum* (D'Orbigny).

Original description.—Polyp turbinate, solitary, subpedunculate; septa numerous, well developed; in one half the calyx they are regularly radiate, but in the other half they are separated into two fascicles by a long groove, at the bottom of which they almost cross in affecting a pinnate arrangement; no columella; tabulae poorly developed.

The principal character of the genus does not permit its confusion with any other cyathophylloid. (Translation from Milne-Edwards and Haime, 1851, p. 354.)

Discussion.—The close relationship between *Hallia* and *Aulacophyllum* has already been discussed. It is probable that certain species that fall into one genus are more closely allied to species in the other than to forms which are placed with them in the same genus.

Simpson (1900, p. 210) withdrew certain species from *Aulacophyllum* into a new genus, *Odontophyllum*, on the basis of carinate septa. The genotype, *O. convergens*

(Hall), exhibits wavy septa like those of *Cymatasma* Hill and Butler (1936, 516-527) and *Hallia vesiculata*, but this character is neither constant nor conspicuous nor is it diagnostic; therefore the writer does not consider *Odontophyllum* Simpson to be a valid genus.

Aulacophyllum is represented in the Traverse by one species in the Petoskey zone, two in the Gravel Point zone.

AULACOPHYLLUM BILATERALE

Sloss, n. sp.

Plate 9, figures 18-20, text figure 5

External characters: Corallum simple, curved ceratoid. Holotype measures 30 mm in maximum diameter, 75 mm in height. Calyx and epitheca unknown.

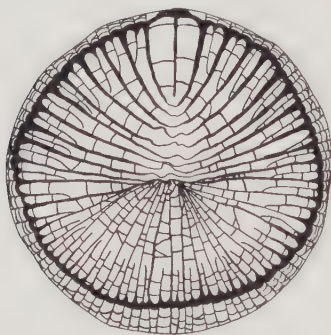


FIG. 5.—*Aulacophyllum bilaterale* Sloss, n. sp.
Diagrammatic transverse section, $\times 1\frac{1}{2}$.

Transverse section: Approximately 46 major septa present; arranged radially in counter quadrants, pinnately arranged about short undilated cardinal septum in cardinal quadrants. Major septa of cardinal quadrants markedly dilated within tabularium; their ends connected across cardinal locus by fine wavy processes, which enclose a cardinal fossula. Minor septa extend over one half the distance from periphery to axis; contracline or contratangent in cardinal quadrants. Dissepimentarium bounded axially by a narrow stereozone formed by the dilation of inner ring of dissepiments.

Longitudinal section: No tabulae. Lumen occupied by undifferentiated dissepiments and tabellae which enclose larger vesicles on the cardinal than on the counter side but are nowhere arranged in order or series.

Discussion.—The species is known only from the holotype, a well-preserved specimen which adequately exhibits the specific characters.

There are some interesting changes exhibited during the ontogeny of the holotype. At a position 7 mm above the base of the corallum the dilated septa of the cardinal quadrants are crowded into about one quarter of the lumen, and the fossular structure is obscure. In the alar position there are three septa that appear to cross directly through the axis and are fused to the corresponding septa on the other side. At this stage there is a prominent peripheral stereozone. Twenty millimeters higher the full specific characters appear; the peripheral stereozone has migrated axially to bound the dissepimentarium; the fossulum is developed, and the reduction of the cardinal septum is evident. In the late ephebic or gerontic portion of the corallum, the specific characters are obscured by the diminished relative dilation of the septa and the appearance of a secondarily imposed radial symmetry, which replaces the pinnate arrangement.

The species differs from *Hallia vesiculata*, which it superficially resembles, by the reduction of the cardinal septum. From *Aulacophyllum hemicrassatum* it is distinguished by the lesser dilation of the septa. Nondilate septa in the counter quadrants separates the species from *A. mesodilatum*.

Type locality.—Grass roots and bed of small stream, $1\frac{1}{2}$ miles east of Bay View on U. S. Highway 31, 200 yards east of intersection of Michigan Highway 131. NW $\frac{1}{4}$ sec. 34, T. 35 N., R. 5 W., Emmet County, Mich.

Holotype.—Walker Museum, U. C. no. 38710.

AULACOPHYLLUM HEMICRASSATUM

Sloss, n. sp.

Plate 9, figures 9, 10, text figure 6

External characters: Corallum simple, curved trochoid. Holotype 40 mm in diameter, 45 mm high. Calyx deep, paraboloid not known in detail. Epitheca thin, exhibits growth annulations and septal grooves.

Transverse section: Forty-eight major septa; all but cardinal dilated within tabu-

larium, which is bounded by pendant-shaped stereozone; septa of cardinal quadrants much more highly dilated than those of counter quadrants, enclose fossulum occupied by short cardinal septum. Dissepimentarium confined to narrow peripheral band containing fine septa and numerous concentric dissepiments.

Longitudinal section: Tabularium largely occupied by dilated septa connected by a few short tabellae. Dissepimentarium appears 10 mm above base, does not become over 3 mm wide.

Discussion.—This species appears to be quite close to *A. bilaterale*, differing from it in more marked septal dilation and shorter minor septa and correspondingly reduced dissepimentarium. *A. hemicrassatum* is an intermediate form between *A. bilaterale* and an undescribed species from the Jeffersonville limestone of Indiana, and the Davenport limestone of Vandruff's Island, Illinois. In the latter coral the septa of the cardinal quadrants are so dilated as to be laterally contiguous within the tabularium. Both the latter species approach *Papliophyllum elegantulum* Stumm (1937, p. 430) but differ from the Nevada form in lacking the peripheral dissepimental zone.

The species is known from a single specimen in the Gravel Point zone and from the Lower Ferron Point formation of Rockport, Alpena County, Mich.

Type locality.—Gravel Point zone, west end Petoskey Portland Cement Company quarry. SW $\frac{1}{4}$ sec. 2, T. 34 N., R. 6 W., Emmet County, Mich.

Holotype.—Walker Museum, U. C. no. 38709.

AULACOPHYLLUM MESODILATUM

Sloss, n. sp.

Plate 9, figures 11–13

External characters: Corallum curved ceratoid, epitheca thin, bearing septal grooves and growth annulations. Diameter of holotype 55 mm at periphery of calyx, 70 mm high. Calyx cupshaped, 25 mm deep; walls descend abruptly from periphery, center occupied by low axial boss. Prominent cardinal fossulum placed at outside of curve of corallum. Septa of cardinal quadrants very thick, stand well above calicular floor

pinnately arranged about fossulum. Septa of counter quadrants less prominent.

Transverse section: Forty-six major septa present, all heavily dilate within tabularium, those of cardinal quadrants more so than others. Cardinal septum extends about

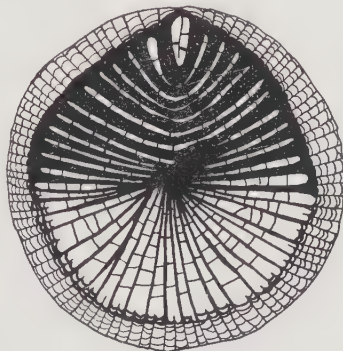


FIG. 6.—*Aulacophyllum hemicrassatum* Sloss, n. sp. Diagrammatic transverse section, $\times 2$.

one half distance to axis; neighboring septa arranged pinnately, extend to axis. Septa of counter quadrants radially arranged near periphery, tend to become fasciculate at axial ends. Dissepimentarium restricted to peripheral 3 mm of lumen. Septa very fine within dissepimentarium, dissepiments concentric, numerous. Dissepimentarium bounded by ring of dilate dissepiments, beyond which minor septa extend but slightly.

Discussion.—This form is exceedingly close to, if not conspecific with, a form from the Cedar Valley (U. C. no. 25625). Both have dilate septa within the tabularium, and pinnate arrangement of the septa of the cardinal quadrants, but the Iowa form is smaller and has a wider dissepimentarium.

The species is known from a single well-preserved specimen collected from the "upper Blue shale" of the top of the Gravel Point stage.

Type locality.—Bell quarry, 2.3 miles east of Charlevoix County line on U. S. Highway 31. NE $\frac{1}{4}$ sec. 8, T. 34 N., R. 6 W., Emmet County, Mich.

Holotype.—Walker Museum, U. C. no. 38704.

Genus *DIVERSOPHYLLUM* Sloss, n. gen.

Genotype, *Diversophyllum traversense* (Winchell).

Cylindrical or ceratoid simple rugose corals with long, unornamented septa, and vertically elongate concentric dissepiments; tabulae flat or domed, often incomplete but not commonly differentiated; septa characteristically exhibiting gerontic lonsdaleoid retreat.

Genus differs from *Tabulophyllum* Fenton and Fenton (1923, p. 30) in exhibiting definite and persistent minor septa, from *Diphyphyllum* Lonsdale (1845, p. 622) and *Diphystroton* Smith and Lang (1930, pp. 177-199) in solitary habit.

Discussion.—The type species exhibits such extreme variation in external shape and internal structure that the relationships of the genus are not readily apparent. One end of the variational series is represented by a ceratoid form with flat tabulae and numerous inclined dissepimental rows as in *Campophyllum* Milne-Edwards and Haime; at the other end of the series are attenuate cylindrical corals with reduced dissepimentaria and highly arched tabulae. Inasmuch as certain large specimens exhibit flat tabulae and wide dissepimentaria in the ephebic portion of the coralla and arched tabulae with restricted dissepimentaria neanically, it is felt that the latter condition is of greater phylogenetic significance. Small cylindrical specimens and immature stages of large ceratoid specimens exhibit many points in common with genomorphic forms of *Lithostroton* Fleming described by Smith and Lang.

The genus *Tabulophyllum* Fenton and Fenton has been made the repository of a variety of corals of different affinities. As defined by the genotypic species, *T. rectum* Fenton and Fenton, the genus may include only those species that have irregular, reduced, or rudimentary minor septa. It is possible that *T. ehlersi* Fenton and Fenton and *T. rotundum* Fenton and Fenton are referable to *Diversophyllum*. Without taking account of possible convergence *Tabulophyllum* and *Diversophyllum* appear closely related. Both have long major septa, longitudinally attenuate dissepiments, and exhibit a lonsdaleoid trend. However, *Tabulophyllum* does not seem to play any part in the phylogenesis of Carboniferous genera; it seems, instead, to represent a degeneracy of the *Diversophyllum* stock.

DIVERSOPHYLLUM TRAVERSENSE (Winchell)

Plate 11, figures 13-23; plate 12,
figure 22, text figure 7

Zaphrentis traversensis WINCHELL, 1866, The Grand Traverse Region, p. 90.

Cyathophyllum houghtoni ROMINGER, 1876, Michigan Geol. Survey, vol. 3, pt. 2, p. 104; *Not* HALL, 1876, III. Devonian Fossils (Albany: Weed, Parsons and Company), vol. XXX, figs. 1-2.

Tabulophyllum houghtoni FENTON and FENTON, 1923, "Hackberry stage," Michigan, Univ., Mus. Geology, Contr., vol. 1, p. 31.

Original description.—Fossette rudimentary. Differs from *Cyathophyllum simplex* Hall in its more abundant epitheca, less contorted lamellae, its finely vesicular outer zone, and its more elongated and erect form. Often attached obliquely (Winchell, 1866, p. 90).

External characters: Corallum simple, cylindrical to ceratoid, one specimen exhibiting increase by lateral gemmation. Average ceratoid specimen measures 30 mm in greatest diameter, 75 mm in height; average cylindrical specimen 15 mm by 75 mm. Largest specimen discovered measures 33 mm by 150 mm. Epitheca thick, lacks septal grooves, bears deep growth constrictions. Periodic rejuvenation characteristic, leaves edges of abandoned calices protruding around corallum as series of sharp, up-turned, frill-like ridges. Calyx depth about equal to radius, walls steeply dipping to domed, flat, or slightly concave floor, which may exhibit a low axial boss or shallow axial pit. Several major septa extend to axis, meet without torsion or formation of axial complex.

Transverse section: Thirty-two to 34 major septa extend from peripheral stereozone of variable width, either anastomose subaxially or extend to axis. Minor septa extend at least one-half distance to axis in ephebic sections of ceratoid coralla, restricted or lacking in neanic sections of cylindrical coralla. Gerontic sections of large coralla exhibit lonsdaleoid withdrawal of septa from periphery and replacement by large dissepiments. Dissepiments characteristically few, seldom arranged in more than three concentric rings. Peripheral stereozone often repeated within lumen by rejuvenation.

Longitudinal section: Thin cylindrical specimens lack dissepimentarium in neanic

stage, never develop more than two steeply inclined rows of large, elongate dissepiments. Ceratoid specimens develop several axially inclined rows of dissepiments, which may occupy over half the lumen. Peripheral stereozone often involved with dissepimentary rows as result of rejuvenation. Tabulae highly domed in thin cylindrical coralla, less domed in subcylindrical coralla, flat or slightly concave in ceratoid specimens. Large subcylindrical coralla exhibit domed neanic tabulae, flat ephebic tabulae. Tabulae commonly incomplete, rarely differentiated. Some septa that do not extend to axis along whole of their distal ends have axial ridgelike processes on top of tabulae (like amplexoid septa), appear in median section as spines on tabulae.

Discussion.—Winchell's inadequate original description of the species was supposed to be followed by figures. The figures were prepared but never published; they are now at the University of Michigan, where Dr. G. M. Ehlers has compared them with Winchell's specimens in the collections of Alma College and has been able to recognize the figured specimens. One of the figures bears the inscription "type" in Winchell's handwriting. Whether this unpublished designation suffices to make the specimen the holotype or whether it should be considered a lectotype designated by the present writer is an academic question of no real importance. The specimen is an asymmetrically cut longitudinal section with half a transverse section shown on one end. Dr. Ehlers has found the other half of the specimen in the University of Michigan collections, and from the two halves the specific characters can be made out. The specimen is an intermediate type with slightly domed tabulae, rather short minor septa, and a dissepimentarium restricted to the peripheral one-third of the lumen.

The writer has compared *Diversophyllum traversense* (Winchell, 1866) with the types of *Cyathophyllum houghtoni* Rominger, 1876, and found the latter to be a synonym. The distinction between *Diversophyllum* and *Tabulophyllum* Fenton and Fenton has already been discussed.

It may be demonstrated that there is a complete intergradation between specimens with ceratoid and cylindrical coralla, flat

tabulae and arched tabulae, wide dissepimentaria and restricted dissepimentaria, long minors and short minors. It is more difficult, however, to explain why this variation exists. Wells (1937) has suggested that

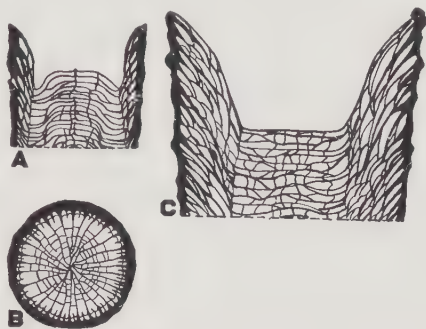


FIG. 7.—*Diversophyllum traversense* (Winchell). A, B, Diagrammatic longitudinal and transverse sections of a specimen exhibiting domed tabulae and a restricted dissepimentarium, $\times 1\frac{1}{2}$; C, diagrammatic longitudinal section of a specimen with flat tabulae and a wide dissepimentarium, $\times 1\frac{1}{2}$.

broadly conical forms of *Heliophyllum halli* are the result of differential growth rate, the polyp growing faster than the corallum, but the reasons for the differential growth rate are not made clear. It seems possible that in the teeming habitat of a bioherm some individuals might be crowded so that certain structures would become reduced and others warped to allow the function of the polyp to proceed. The fact that the coralla are not polygonal does not exclude the possibility of crowding by soft-bodied organisms. Moreover, at locality 1, in the "upper Blue shale," which carries an exceptionally rich fauna characterized by a profusion of encrusting forms and many large colonies of *Prismatophyllum*, thin cylindrical specimens of *Diversophyllum* are common; whereas at locality 5 the species occurs in a different facies, which does not bear so abundant a fauna, the species attains great size, and small cylindrical forms are unknown.

The species has been recognized by the writer as occurring in the Upper Alpena limestone of the eastern side of the Peninsula, the Cedar Valley formation of Iowa, and the limestones of Hay River, Northwest Territory, Canada.

Type locality.—Winchell's (1866) locality number 861b, NW $\frac{1}{4}$ sec. 2, T. 34 N., R. 6 W. The specimens were probably collected from low cliffs on the lake shore near the present site of the Petoskey Portland Cement quarry. The horizon was probably in the upper part of the Gravel Point zone, possibly the "lower Blue shale."

Other localities.—Bell quarry, 2.3 miles east of Charlevoix County line on U. S. Highway 31. NE $\frac{1}{4}$ sec. 8, T. 34 N., R. 6 W., Emmet County, Mich.

West end Petoskey Cement Company quarry. SW $\frac{1}{4}$ sec. 2, T. 34 N., R. 6 W., Emmet County, Mich.

Holotype.—One half at Alma College, Michigan (Winchell's no. 2720); one half at University of Michigan, Ann Arbor.

Genus DISPHYLLUM de Fromentel, 1861

DE FROMENTEL, 1861, Introduction a l'Etude des Polytypes Fossiles, Paris, p. 302; revised by LANG and SMITH, 1935, Geol. Soc. London Quart. Jour., vol. 91, p. 544.

Genotype, *Disphyllum caespitosum* (Goldfuss), by subsequent designation (Lang and Smith, 1934, p. 78).

Revised diagnosis.—Phaceloid rugose corals in which increase may be lateral or calicular; the septa rarely reach the axis, but are usually long and typically thin; the tabulae are sometimes complete, though generally incomplete and differentiated into a transverse axial and an inclined periaxial series; with dissepiments typically small, strongly arched, sometimes of one, but frequently of two, kinds: an inner, single series of globose, distally directed dissepiments, and an outer series of flat or arched dissepiments (Lang and Smith, 1935, p. 545).

Discussion.—Lang and Smith have lumped nine genera into *Disphyllum* and have clarified the confused situation surrounding *Cyathophyllum caespitosum* Goldfuss. It seems possible to the writer that the simplification has been carried too far so as to include some obviously unrelated species in the same genus. A division based on the differentiation of dissepiments and tabulae would be logical, but until the relationships are more clearly understood it is probably better to retain the simplified classification. The present conception of this genus again serves to illustrate the doubtful value of colony form as a generic character.

DISPHYLLUM PANICUM (Winchell)

Plate 9, figures 25–27

Cyathophyllum panicum WINCHELL, 1866, The Grand Traverse Region, p. 90.

Diphyphyllum panicum ROMINGER, 1876, Michigan, Geol. Survey, vol. 3, pt. 2, p. 125, pl. 47, fig. 3.

Diplophyllum panicum GRABAU and SHIMER, 1909, North American Index Fossils, vol. 1, p. 75.

Cylindrophyllum panicum EHLERS and WHITE, 1932, Michigan, Univ., Mus. Paleont., Contr., vol. 4, p. 93.

Discussion.—Ehlers and White have published adequate description and figures of the species and very logically referred it to *Cylindrophyllum* Simpson. Lang and Smith (1935, p. 544) consider *Cylindrophyllum* to be synonymous with *Disphyllum*, so the species *panicum* is referred to the latter genus. Species that have been placed in *Cylindrophyllum* differ from the genotype of *Disphyllum* in that they lack differentiated tabulae and dissepiments. It is possible that further study will show that *Cylindrophyllum* should be reinstated.

Ehlers and White (1935, p. 97) have described a species from the Potter Farm formation at Alpena as *Cylindrophyllum hindshawi*. In the opinion of the writer this form should be considered a variant of *D. panicum* rather than a distinct species.

According to Ehlers and White typical examples of the species are also found in the Potter Farm formation indicating a close relationship between the faunas of the Potter Farm formation and Petoskey zone.

Localities.—Specimens in the Walker Museum collection are from the following localities:

Petoskey zone, "Mud Lake" quarry, East Bay View (Kegonic), NE $\frac{1}{4}$ of NW $\frac{1}{4}$ sec. 34. T. 35 N., R. 5 W., Emmet County, Mich.

Petoskey zone, Northern Lime and Stone Company quarry, Petoskey, NE $\frac{1}{4}$ sec. 32, T. 35 N., R. 5 W., Emmet County, Mich.

Type material.—The holotype is possibly at Alma College, Mich. Other material collected by Winchell and specimens figured by Rominger are at the University of Michigan, Ann Arbor. Comparative material collected by the writer is at Walker Museum, University of Chicago.

Genus PRISMATOPHYLLUM Simpson, 1900

Genotype, *Prismatophyllum prisma* Lang and Smith, 1935, Geol. Soc. London Quart. Jour., vol. 91, p. 558; *P. rugosum* Simpson, 1900, New York State Mus. Bull., vol. 8, p. 218.

Revised description.—Cerioid rugose corals with septa that may or may not reach the axis; tabulae typically differentiated into a horizontally disposed axial series and an axially inclined periaxial series; and typically numerous, small, globose dissepiments. (Lang and Smith, 1935, p. 559.)

Discussion.—The genus has been involved in nomenclatorial difficulties due to the fact that Milne-Edwards and Haime in describing "*Cyathophyllum rugosum*" wrongly thought they were dealing with "*Astrea rugosa*" Hall. Therefore when Simpson erected the genus *Prismatophyllum* on Milne-Edwards and Haime's "*rugosum*" he used a homonym for the genotype. This confusion has been cleared by Lang and Smith (1935, pp. 538–590) who renamed the genotype *Prismatophyllum prisma*.

Lang and Smith discuss *Prismatophyllum* as a logical link between the phacelloid *Disphyllum* and the plocoid *Phillipsastrea*. Traverse species of *Prismatophyllum* commonly have individuals within a colony or portions of cerioid colonies that exhibit a phacelloid trend. This variation may be induced by environmental stimuli. T. W. Vaughan (1917, p. 202) has shown that on modern coral reefs the species inhabiting the lagoons are dendroid or phacelloid, whereas those on the sea slope are cerioid or plocoid. He explains that, under lagoonal conditions of heavy sedimentation and turbid water, the cerioid and plocoid forms, with their wide horizontal surfaces, offer great areas for burial by sediment. Thus they might not survive, although dendroid and phacelloid colonies would live since the separate individuals would gather little sediment. Thus it is possible to account for the shifting in the colony form of one species from cerioid to phacelloid purely as the result of environmental stimuli. It is, however, harder to envisage a variation in the direction of plocoid colonies in which the septa of adjoining individuals are confluent, for in the most compactly cerioid colony of *Prismatophyllum* the septa of one individual usually meet an interseptal locus of the adjoining corallite, and the bounding wall is always definitely marked.

The genus also appears closely related to *Acerularia* Schweigger, differing from that genus in the lack of an aulos and the character of the tabulae. Certain species of *Prismatophyllum* exhibit dilate dissepiments

and carinae at the axial boundary of the dissepimentarium and in this manner approach the condition of *Acerularia*.

Another possible, though obscure, relationship is with the common solitary form *Heliophyllum*. Both genera are characterized by small globose dissepiments, incomplete tabulae, and prominent arched carinae. Other members of the group, such as *Disphyllum*, *Lithostrotion*, and *Phillipsastrea*, have recognizable solitary relatives, but many forms of *Heliophyllum* increase by lateral and parricidal gemmation, a character indicative of colonial relationship.

PRISMATOPHYLLUM PERCARINATUM

Sloss, n. sp.

Plate 10, figures 6–9

External characters: Cerioid corals typically forming broad, flat, or dorsally convex colonies arising from a central point of attachment. Under side bears a thin annularly wrinkled holotheca with fine septal

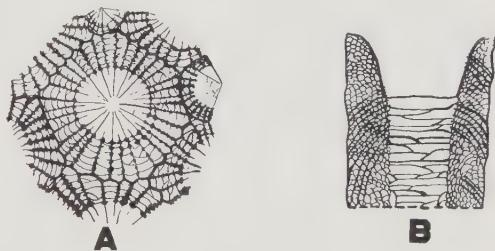


FIG. 8.—*Prismatophyllum percarinatum* Sloss, n. sp. A, Diagrammatic transverse section, $\times 2$; B, diagrammatic longitudinal section, $\times 2$.

grooves. Colonies may attain 30 cm in diameter, are commonly 12 to 16 cm. Individual adult corallites polygonal, average 10 mm in mean diameter. Immature individuals commonly circular in outline. Some colonies bear individuals protruding above general surface or projecting from edge, in which case these individuals are circular in cross-section and phacelloid in their relation to neighboring corallites.

Calices extremely variable, being different in form between colonies or between individuals of the same colony. Most frequently occurring calyx type bears horizontal peripheral platform occupying one half the radius, a deep calicular pit at the axis. All degrees occur between this central type and forms in which the calicular wall descends

abruptly from periphery as in *P. profundum* (Hall and Whitfield). Ephebic calices bear edges of 38 to 40 denticulate, highly carinate septa. Majors and minors not differentiated near periphery; septa taper axially, majors extending close to axis.

Transverse section: Dissepimentarium occupies one-half the radius, bounded axially by large carinae, occasionally by dilate dissepiments, to form a discontinuous wall similar to, but not homologous with, aulos of *Acervularia* Schweigger (Smith and Lang, 1931, p. 85). Major septa approach but do not attain axis, minor septa extend but slightly beyond dissepimentarium. All septa dilate, carinate within dissepimentarium; fine, unornamented within tabularium. Character of carinae variable; three types may occur in one individual—large diamond-shaped areas, simple yard-arms (Hill, 1935, p. 501), or prolongations of angles of "zig-zag septa" (Hill and Butler, 1936, p. 523). Dissepiments concentric, numerous, fine. Boundary between individuals fine but distinct.

Longitudinal section: Numerous small globose dissepiments arranged in rows, which vary in same manner as calicular platform. Rows may be horizontal at periphery, descend abruptly at margin of dissepimentarium, or descend directly from periphery. Dissepimentarium restricted in neanic stage, quickly widens to occupy one-half the lumen in ephebic stage. Tabulae numerous, horizontal, complete or incomplete, not differentiated. Arched carinae, spaced approximately 0.3 mm apart, prominent wherever plane of section transects plane of septum, and extending but slightly into tabularium.

Discussion.—*Prismatophyllum percarinatum* is the coral of the familiar "Petoskey stone" of northern Michigan. It has been identified by most workers in the area as *P. davidsoni* (Milne-Edwards and Haime) but it has been shown (Stewart, 1938, p. 53) that specimens of the latter species from the accepted type locality in France do not exhibit carinae. The aulos-like character of the boundary of the dissepimentarium gives the species the appearance of an *Acervularia*, but it differs from that genus as redefined (Smith and Lang, 1931, p. 85) in lacking differentiated tabulae and possessing nu-

merous dissepiments. The species differs from *P. profundum* and *P. inequalis* of the Iowa Devonian, for these forms have domed axial, horizontal periaxial tabulae and lack dilate septa. There are many points in common between *P. percarinatum* and *P. whitfieldi* Stewart (1938, p. 52) from the Columbus limestone of Ohio, but the Michigan species differs widely from the Ohio species in colony form, has a larger number of septa per corallite, lacks the joining of major septa at the axis, has more horizontal, more commonly complete tabulae, and smaller, more numerous dissepiments.

P. percarinatum occurs in great abundance in the calcareous shales of the Gravel Point zone, in which colonies of all sizes are among the most common fossils.

Type locality.—Bell quarry, 2.3 miles east of Charlevoix County line on U. S. Highway 31. NE $\frac{1}{4}$ sec. 8, T. 34 N., R. 6 W., Emmet County, Mich.

Holotype.—Walker Museum, U. C. no. 38746.

PRISMATOPHYLLUM PAUCISEPTATUM

Sloss, n. sp.

Plate 10, figures 10-13

External characters: Subcerioid corals forming spheroidal masses, which arise from a central point of attachment. Individuals on lower side of colony intersect surface at a low angle. Elsewhere individuals intersect surface at right angles. No holotheca present. Individuals phacelloid to cerioid in relation to one another. Some circular in cross-section, barely touch neighboring corallites; others are polygonal, in contact with adjacent corallites at all points on periphery. Sections through interior of colony indicate that relation is cerioid below surface, a condition difficult of explanation in view of absence of secondary tissue between individuals.

Ephebic corallites average 18 mm in diameter. Depth of calyx approximately one-half diameter; calicular walls descend abruptly from periphery to flat floor occupying two thirds the diameter. Many individuals exhibit calicular rejuvenation. Septa short, thick, widely spaced, coarsely carinate and denticulate. Minor septa rarely apparent.

Transverse section: Sixteen to 18 tapering

major septa of unequal length present in ephebic stage. Few septa approach axis, most restricted to peripheral two-thirds of lumen. Septa slightly dilate, commonly "zig-zag," ornamented with diamond-shaped carinae within dissepimentarium; thin, wavering, unornamented in tabularium. In neanic stage major septa persistent to axis, minors short but prominent. Amplexoid retreat of both series marked in ephebic stage. Minors commonly lacking in late ephebic or gerontic stage. Dissepiments numerous, restricted to narrow peripheral border, concentric if minor septa are present, herring-bone if minors are absent.

Longitudinal section: Dissepimentarium restricted to within 2.5 mm of border. Dissepiments numerous, globular, arranged in subvertical rows. Tabulae numerous, incomplete but not differentiated, commonly horizontal, occasionally domed or sagging. Arched carinae spaced approximately 0.6 mm apart; carinae not prominent.

Discussion.—The taxonomic position of this species is in doubt because its colonial form places it as an intermediate type between the phacelloid *Disphyllum* and the cerioid *Prismatophyllum*. At present, in view of the preponderance of polygonal corallites it seems best to consider the species as an aberrant amplexoid *Prismatophyllum* and wait for the discovery of more specimens to indicate the true generic affinity.

The species serves admirably to point out the artificial nature of the criteria used for generic distinction among the compound corals. At present the corals of the group under discussion are called *Disphyllum* if they are phacelloid, *Prismatophyllum* if cerioid, *Phillipsastrea* if plocoid, or *Macgea* if solitary. It has been shown that a single species may vary so widely under the influence of environmental stimuli as to fall into two or more of these artificial categories. Moreover, it is likely that each "genus" contains forms of varied origin. Under the same ecologic conditions corals of widely separated stocks would tend to build colonial structures of similar form and thus would be included in the same "genus." It is hoped that after many more detailed studies of the internal structures of the individuals of colonial type have been made,

the true relationships will appear. Then the taxonomy may be based upon the morphology of the individual, and the differences in colonial habit will be reduced to varietal significance. Unfortunately the present state of knowledge will not permit such a rearrangement, and an attempt would only lead to further confusion.

P. pauciseptatum is known from one large colony from the float of the Petoskey zone at East Bay View.

Type locality.—"Mud Lake" quarry, East Bay View (Kegonic), NE $\frac{1}{4}$ sec. 34, T. 35 N., R. 5 W., Emmet County, Mich.

Holotype.—Walker Museum, U. C. no. 38752.

PRISMATOPHYLLUM CRISTATUM (Rominger)

Plate 10, figures 1–5

Cyathophyllum cristatum ROMINGER, 1876, Michigan Geol. Survey, vol. 3, pt. 2, p. 108.

External characters: Cerioid corals with polygonal ephebic individuals averaging approximately 17 mm in mean diameter; small, immature individuals round in cross-section. Calices typically exhibit narrow horizontal calicular platform and deep, cup-shaped calicular pit. Major septa approximately 20 in number, carinate and denticulate, approach axis on floor of calicular pit. Minor septa finely carinate, do not extend beyond calicular platform.

Transverse section: Major septa approach close to axis in neanic and early ephebic stages, retract toward periphery gerontically. Majors markedly dilate within dissepimentarium, taper to fine line in tabularium. Carinae not prominent. Minor septa extend not over one-third distance to axis. Dissepiments numerous, concentric to herring-bone in pattern.

Longitudinal section: Dissepiments numerous, small, globular, arranged in steeply inclined rows. Tabulae closely spaced, horizontal, commonly incomplete but not differentiated. Carinae not prominent, closely spaced.

Discussion.—This species, although much larger, appears in transverse section and calicular view to be quite similar to *P. percarinatum*; both species have horizontal calicular platforms and dilate septa within the dissepimentarium. *P. cristatum* differs

from *P. percarinatum*, however, in having a restricted dissepimentarium, amplexoid septa, and in lacking well-developed carinae—all interpreted as evidence of degeneracy. From *P. pauciseptatum*, which it closely resembles in longitudinal section, the species is distinct by reason of the smaller dissepiments, more closely spaced tabulae, more numerous septa, better-developed minor septa, and constant cerioid form.

Rominger's holotype is an execrable specimen, a fragment of a colony with no calices preserved. The specific characters are clearly visible, however, and the discovery of two more specimens has made a redefinition of the species possible.

Type locality.—Rominger gives no specific locality, merely stating that the species "occurs rarely in the strata of Little Traverse Bay." It is probable that he collected his specimens from the now-covered lake bluff outcrops of the Gravel Point zone at the mouth of Bear Creek, where the town of Petoskey now stands.

The two hypotypes were all collected by Mr. A. W. Slocum at the following locality:

Bell quarry, 2.3 miles east of Charlevoix County line on U. S. Highway 31. NE $\frac{1}{4}$ sec. 8, T. 34 N., R. 6 W., Emmet County, Mich.

Type material.—The holotype is at the University of Michigan, no. 5322, where also is deposited one of the hypotypes. One hypotype is at Walker Museum, University of Chicago.

PRISMATOPHYLLUM CRISTATUM

MICROCARINATUM Sloss, n. var.

Plate 10, figure 14

External characters: Dimensions and manner of growth as in *P. cristatum*. Calicular walls descend abruptly from periphery to deep calicular pit. Septa prominent, fine, occasionally exhibit very fine, barely visible carinae.

Transverse section: Differs from *P. cristatum* in lack of septal dilation and apparent carinae, otherwise similar.

Longitudinal section: Differs from *P. cristatum* in lack of apparent carinae, otherwise similar.

Discussion.—The variety exhibits the bell-shaped calices described by Rominger, but, as the internal structure does not fit

that of Rominger's type specimen, a distinction has been made on the basis of the differences outlined above. It is possible that further study will show that the variety should be given specific status; the two forms are quite easily separated by external characters, but as has been indicated elsewhere such characters are not wholly trustworthy.

Rominger, working with poorly preserved material, evidently confused the two forms (they occur in the same beds) as his original description mentions characters found in both forms.

Type locality.—Bell quarry, 2.3 miles east of Charlevoix County line on U. S. Highway 31. NE $\frac{1}{4}$ sec. 8, T. 34 N., R. 6 W., Emmet County, Mich.

Type.—Walker Museum, University of Chicago, U. C. no. 18402.

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